An analysis of the length of hospital stay for diabetes patients by the Box-Cox transformation model when variances vary among hospitals

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Abstract:

In this paper, we consider an analysis of LOS of type 2 diabetes patients by the Box-Cox transformation model (BC MLE) when variances of error terms vary among different hospitals. The maximum likelihood estimator (BC MLE) which maximizes the likelihood function under the normality assumption is used for the estimation of the BC model. However, Showalter (1994) reported large biases of the BC MLE when heterogeneity exists in variances. Heteroscedasticity is a very important problem in the BC model, and it was argued even in the original paper of Box and Cox (1964). Especially, for the LOS, variances are often very different even after controlling for the characteristics of diseases, treatments and patients among hospitals. We first propose a new estimator which is consistent even under heteroscedasticity. We then analyze LOS of the type 2 diabetes patients using the data set of 1,571 patients collected from 17 general hospitals in Japan by the proposed method. Finally, we evaluate financial effects on the Japanese medical system based on the obtained results.

The variables found to affect the LOS were the purposes of hospitalization, numbers of secondary diseases and complications, acute hospitalization, and principal disease E117. We found surprisingly large differences in LOS among hospitals, even after eliminating the influence of patient characteristics and principal disease classifications. There were also large differences among estimates of the variances, and feasibility of the proposed model is strongly suggested. We finally evaluated the effects of shortening LOS and found that as much as 50 billion yen could be possibly save by reducing LOS for type 2 diabetes patients.